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ABSTRACT

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Memory for Physical Features of Discourse as a function of their Relevance

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Running Head: Memory for Physical Features

Abstract

Memory for sex of the speaker and language of presentation of a spoken message was high and reliably better when the features were instrumental for comprehending the message than when they were not. This suggests that the physical characteristics of an event may be deeply or elaborately encoded when they are meaningful in light of the task demands. Furthermore, memory about the acquisition event was superior when its physical characteristics matched those of the test probe (e.g., both were presented in a male voice) than when they mismatched. This facilitation was greater when the feature was meaningful than when it was non-meaningful. It was hypothesized that memory of an event could occur either by retrieving the episodic trace representing the particular event or by constructing the event from an abstract, thematic code that integrates several, conceptually related events. We suggest that elaborate encoding--relating an event to a structure of other events--facilitates memory because it permits the use of thematic knowledge at the time of retrieval.

One straightforward prediction that has frequently been drawn from Craik and Lockhart's (1972) levels of processing framework is that the memory trace resulting from semantic operations should be more durable than that resulting from non-semantic operations (such as coding of physical or phonological features). And, in fact, such is the general finding for verbal material (e.g., Craik & Tulving, 1975; Hyde & Jenkins, 1969). Consistent with this approach were early estimates that peripheral representations of auditorily presented messages lasted for only a few seconds (e.g., Bryden, 1971; Crowder & Morton, 1969). It soon became apparent, however, that these were severe underestimates of how long an observer could retain the physical characteristics of a message. Evidence quickly mounted to show that subjects could remember the physical attributes of a visually presented message (e.g., typescript) after several minutes and even after several weeks had elapsed (Hintzman, Block, & Inskeep, 1972; Kolers & Ostry, 1974). Similarly, Geiselman and his colleagues showed that for auditorily presented messages, subjects could retain the identity of the speaker, whether male or female, for several minutes after the original presentation (Geiselman, 1979; Geiselman & Bellezza, 1976, 1977; Geiselman & Glenny, 1977). Typically, the evidence demonstrating this long-term retention effect was based on the finding that words were recognized better if they were re-presented in the same voice at the time of test. For example, Craik and Kirsner (1974) found that after a 2-min delay, words that were tested in the same voice (male or female) as at

presentation were recognized slightly better than those words tested in a different voice (.89 vs .86). The advantage of the "same-voice" test appears to fluctuate somewhat from one study to the next, but generally seems to be in the range of 3 to 10 per cent (Craik & Kirsner, 1974; Geiselman & Bjork, 1980; Geiselman & Glenny, 1977).

A more direct way to measure memory for the voice of the input event is simply to re-present the event later and ask the subject to recall whether it was originally presented in the male or in the female voice. Craik and Kirsner (1974), Hintzman et al. (1972), Geiselman (1979), and Geiselman and Bellezza (1976, 1977) have conducted a variety of experiments revolving around this basic procedure, varying whether the voice-recall test was preceeded by a free recall test or by an old-new recognition test, and whether the test items (words or sentences) on the voice-recall test included all the originally presented items or only those remembered on the first test. Overall, recall accuracy of the speaker of the test item was above chance (.50), but frequently not by much. Across six experiments using this basic procedure, voice-recall accuracy varied from .58 to .71, with a mean score of .63. (As a rough comparison, when the subjects judged the same test items on an old-new recognition test, the Hit rates averaged .80.) Thus, while some information about the speaker's voice is retained for later use, the amount preserved is minimal.

One explanation of the typically poor recall of physical features is that we do not perceive them as being meaningful

parts of the verbal message. Instead, we perceive the semantic attributes as being relatively more meaningful, and consequently we elaborately encode and later remember only the semantic attributes. In support of this suggestion, Wickens (1970) reported that release from proactive interference (PI) in the Brown-Peterson short term memory task was greater when the shift occurred along semantic dimensions than along non-semantic dimensions. That is, semantic changes seem to have greater effects on encoding operations than do physical changes. It is interesting to note that the effect of a physical change--as measured by the magnitude of PI release--is related to the "wordness" of the stimulus. Changing the physical characteristics of the stimuli on the shift trial led to more PI release when the stimuli were nonsense syllables than when they were words. In a similar vein, Kirsner (1973) found that word recognition was superior when the target word was re-presented at test in the same typescript as at learning than if in a different typescript. More important, the effect was magnified when the stimuli were nonsense strings of letters.

Why should the wordness of a stimulus affect the retention of its physical features in this manner? One possibility is that the subject will attend to, or allocate processing capacity to, whatever features of the stimulus are meaningful. Typically, the semantic features are the most meaningful, so that they receive most of the benefit of elaborate encoding operations. However, when there is less inherent semantic information in a message, as in a nonsense syllable, the subject will process its physical features more thoroughly.

It is important to note that we distinguish between the concepts of amount of semantic information ("semanticity") and meaningfulness. In agreement with many of the ideas put forward by Bransford, Franks, Morris, and Stein (1979), we suggest that semanticity reflects a static property of a concept, something akin to its fixed, dictionary definition. Meaningfulness, on the other hand, is situation-specific and correlates more closely with the abilities of the observer and the goals of the particular task. Conceivably, a non-semantic feature could be meaningful if it were related to the goals of the task. For example, if the interpretation of a statement varied depending upon its author, then any physical features that identified the author would be meaningful. If the encoding of information reflects its meaningfulness then non-semantic, but meaningful, features should be elaborately encoded and thus well remembered.

The present study explored how memory for the physical characteristics of a spoken message is affected by their importance in comprehending the message. In the first experiment, memory for the sex of the speaker was observed in a situation where knowledge of the speaker's sex was either instrumental or not for comprehending the message. In the second experiment, two non-semantic features were examined simultaneously, sex of the speaker and language of presentation.

Experiment 1

Method

Subjects. The subjects were 60 male and female undergraduate volunteers from Florida International University and Garces Commercial College.

Procedure and Design. The subjects were randomly assigned to three groups: Voice, Narrator, and Control. In the Voice condition the subjects were told that they would be listening to a tape recording of a simulated divorce proceeding in which the husband and wife answered questions which were posed by a judge. The subjects' task was to decide whether the husband or the wife was primarily responsible for the breakup of the family. No indication was given that there would be a later memory test. The subjects read the judge's question (hand-printed on index cards) for 5 sec and then listened to either the man's or the woman's response. Since the subjects were not told whether the judge addressed the question to the husband or to the wife, they had to listen to whether the response was made in a male voice or in a female voice in order to interpret the response properly. A few sample questions and answers are: How much time do you spend with your children? I spend about 20 hours per week with the children. How often are you responsible for starting a conflict? I am never aware of starting a conflict. Do you ever have violent reactions? I sometimes feel violent. Is your marriage an obstacle to your professional life? My marriage has come in the way of my professional life many times.

There were 68 questions and answers, and the total

presentation time was approximately 9.5 min. Half (34) the answers were recorded in a male voice and half were in a female voice. For counterbalancing purposes there were two different tape recordings, such that the 34 answers that were spoken in the male voice on one recording were spoken in the female voice on the other recording, and vice versa. Half the subjects in the Voice condition listened to one version of the tape and half listened to the other. The procedure was the same for a second group of subjects, the Narrator condition, with the exception that all the responses were narrated by one speaker. For this group, the author of each response, the husband or the wife, was indicated by a sign which read "Frank answered" or "Mary answered." This visual cue was presented immediately after the judge's question and before the tape-recorded response. There were two versions of the tape recording, one narrated entirely by a male speaker and the other by a female speaker. The statements that were attributed to Frank on one version of the tape were attributed to Mary on the other version, and vice versa. In the Control condition, the subjects listened to the same tape recordings that were used in the Voice condition, in which 34 statements were spoken in a male voice and 34 were in a female voice. The Control subjects were not told anything about a divorce proceeding and were not shown the judge's questions; they were instructed only to remember as much as possible about the statements. To equate the presentation rates between the Control and the two courtroom groups, a 5-sec pause between statements was introduced in the Control group.

Immediately following the last statement, all the subjects were given a typed answer sheet listing the middle 60 statements. The subjects were asked to indicate whether each statement was originally spoken by the male or by the female speaker by circling the numbers 1 (positive-male), 2 (unsure-male), 3 (unsure-female), or 4 (positive-female) next to each statement. Unlimited time was permitted to complete the test. The order of the test statements was random with respect to the presentation order.

Results and Discussion

The responses were dichotomized into male (responses 1 and 2) and female (3 and 4). Overall, the subjects more accurately recognized the sex of the speaker in the two structured conditions, Voice (probability correct = .82) and Narrator (.81), than in the Control condition (.66), F (2,57) = 19.96, MSE = .016. (All statistical tests are reported at the α = .05 level, unless indicated otherwise.)

The two most salient features of the results are that recognition of the speaker reflects the importance of the speaker's identity in comprehending the message, and that it is comparable whether the identity of the speaker is conveyed by the physical characteristics of the spoken message (Voice condition) or by an abstract code (Narrator condition). We shall treat these in turn.

From a levels of processing perspective, the fact that memory for a non-semantic aspect of a message was so accurate in the two structured conditions suggests that it was processed

thoroughly. This obviously necessitates a re-evaluation of the original levels of processing assumption, that non-semantic features are given ony shallow processing or that depth of processing is determined by the semanticity of the feature (Bransford et al., 1979).[1] Rather, it appears that whether or not a feature is processed thoroughly--and thus well remembered--depends upon how instrumental it is for comprehending the message. Comprehension is not simply a matter of finding dictionary definitions of all the component words in the message. Instead, comprehension requires evaluating the semantic interpretation in relation to the goals of the task. In the Narrator and Voice conditions, for example, where the goal was to decide who was responsible for the marital breakup, there are very different meanings given to the statement "I spend 20 hours per week with the children" when it is spoken by the husband than when it is spoken by the wife. The words are identical, yet the meaning changes. By comparison, it is less likely that the speaker`s identity would have altered the meaning of the statements in the Control condition, where no structure was provided to induce the subjects to encode the two statements differently (although, see Geiselman & Bellezza, 1977, for slight connotative differences for statements spoken by males and females).

Given that the identity of the speaker was well remembered in the Voice and Narrator conditions, the question arises as to the format in which the information was stored. Hintzman et al. (1972) offered two hypotheses: first, that a literal copy of the

perceptual experience exists in auditory memory (see also Craik & Kirsner, 1974), and second, that the speaker's voice is encoded as an abstract proposition along with the message. The results of the first experiment, in which recognition of the speaker was the same for the Voice and Narrator conditions, suggest that the information was not represented as a literal copy. If a literal copy of the message were accessible, one would have expected better recognition scores in the Voice condition than in the Narrator condition, since the male and female voices were physically different only in the Voice condition (cf. Geiselman & Glenny, 1977). Although many Narrator subjects indicated in an informal questionnaire that they had difficulty following the narration and thought it would be easier to perform the task in the Voice condition, there was no reliable difference between the two (Newman-Keuls, $p > .10$). Another possible explanation is that both the literal code and the abstract code were available in the Voice condition--and only the abstract code in the Narrator condition--but the subjects accessed only the abstract code. One possibility as to why the literal code would not have been accessed in the Voice condition is that the test statements were presented visually. As a result, the test situation may have differed too much from the encoding format to make use of the literal code (cf. Fisher, 1981).

An alternative to explain the retention of the speaker's identity is that the retrieval process is not simply a matter of accessing the appropriate episodic trace, the code representing the original event. Rather, the identity of the speaker of a

given statement may be constructed or inferred from information contained in other statements. Specifically, when listening to the divorce proceeding, the observer constructs one personality profile to characterize the husband and another for the wife. Later, when the test statement is presented, the subject makes a probabilistic decision as to whether the character trait of the test statement more closely fits the husband's or the wife's personality profile. For example, on the basis of the statements made by the two litigants in the divorce proceeding, the subject may abstract that the husband is more lenient with the children than is the wife. Consequently, when later asked who said "I make sure the children are in bed by 8:30," the subject responds "wife" because this type of statement is more consistent with the wife's personality than with the husband's. The subject's memory, then, is not guided by the specific episode that the test statement refers to, but by a more general rule or theme which integrates a series of related episodes (Bransford & Franks, 1971).

Experiment 2

A second experiment was conducted to examine more thoroughly whether the speaker's identity was remembered by retrieving a specific episodic trace or by constructing it from a more general theme. The logic was to vary the physical similarity of the acquisition event and the retrieval cue. If memory is partly mediated by a specific episodic trace, then retrieving the trace should be facilitated by providing a retrieval cue that is

physically similar to the encoding format. If memory is entirely constructed from an abstract code, however, there should be little or no effect of the physical similarity between the acquisition event and the retrieval cue. Experiment 2 also served to extend the findings to a second non-semantic feature, language of presentation.

Method

Subjects. The subjects were 72 male and female English-Spanish bilinguals. All the subjects were undergraduate students at either Florida International University or Garces Commercial College and were paid for their participation.

Procedure and Design. The subjects' task was similar to that in Exp. 1, but with a slight change in the scenario. The experimental subjects were instructed that they would listen to a simulated courtroom proceeding in which the people living in two adjacent houses were arguing over the property rights to a strip of land midway between the two houses. The subjects read the judge's question (written in English) and then listened to a tape-recorded answer made by one of the four litigants: Male-English (ME), Male-Spanish (MS), Female-English (FE), or Female-Spanish (FS). The statements were recorded by four different people. A few sample questions and answers are: Who called the surveyors? We called the surveyors because we wanted to build a fence. Why is there still a problem? They refuse to respect our right to the property. Who has cared for the land? We looked after the land until two years ago. Why is the piece of land so important to you? We had our garden there for years.

The subjects were randomly assigned to one of three groups: Sex-Relevant, Language-Relevant, and Control. Those in the Sex-Relevant condition were told that the two males (ME and MS) lived in one house and that they were opposing the two females (FE and FS), who lived in the other house. The subjects in the Language-Relevant condition were told that the two Spanish-speaking people (MS and FS) lived in one house and that they were opposing the two English-speaking people (ME and FE), who lived in the other house. In both the Sex-Relevant and Language-Relevant conditions the subjects were instructed that they should decide on the basis of the courtroom hearing which household was entitled to the ownership of the debated strip of land. There was no mention of a later memory test. In the Control condition the subjects were not informed about the courtroom scenario, nor were they shown the judge's questions. They were instructed only that they would listen to a tape recording of a series of statements and that they should try to remember as much as possible about the statements.

Every subject listened to one tape recording, which contained 52 statements. The first four statements were brief introductory comments which allowed the subjects to become familiar with the voices of the four speakers. The last 48 statements, which were later tested, contained 12 statements by each of the four speakers. The statements were recorded in a normal speaking voice, with approximately 5 sec between statements for the experimental subjects to read the next question. The average presentation time for all 52 statements

was approximately 7.5 min.

For counterbalancing purposes there were four different tape recordings for the Sex-Relevant and Language-Relevant conditions, so that each statement was spoken equally often by the four speakers across tape recordings. The English and Spanish versions of a statement were judged to be adequate translations of one another by two unbiased raters who did not participate in the experiment. The subjects in the Control group listened to the identical tape recordings as those in the experimental groups. Half of the Control subjects listened to the Language-Relevant tapes and half listened to the Sex-Relevant tapes.

After the final statement, the test phase began and the last 48 statements were re-presented auditorily, 12 by each of the four speakers. (The same group of four people who recorded the courtroom statements also recorded the test statements.) The subjects were asked to indicate which of the four litigants originally made the statement during the courtroom proceeding. The subjects indicated their answers by circling ME, MS, FE, or FS on a printed answer sheet. They were given 10 sec per test item. The order of the test statements was random with respect to the presentation order.

The speaker's voice of the test statement was factorially combined with the speaker's voice of the acquisition statement to yield all 16 possible combinations of acquisition voice X test voice. For example, a statement that was originally spoken by the ME litigant was re-presented in the test phase by the same ME

speaker one quarter of the time, by the MS speaker one quarter of the time, by the FE speaker one quarter of the time, and by the FS speaker one quarter of the time. More generally, for any given statement, the test voice either matched the acquisition voice on both sex and language, on sex only, on language only, or on neither sex nor language. When the language changed from the acquisition phase to the test phase, the test statement was the translation of the acquisition statement.

Speaker of the acquisition statement and speaker of the test statement were manipulated within-subjects. Instructions were manipulated between groups.

Results

The responses were scored in terms of whether or not they preserved the sex and language features of the original statement. For example, if a statement was originally spoken in the ME voice and the subject answered FE, then the language feature was recalled correctly, but the sex feature was recalled incorrectly. For the purpose of clarity, the overall probability of recalling the sex and language features are presented in Table 1 as a function of instructional condition only. A separate analysis was conducted to examine how the scores varied as a function of the physical similarity between the test statement and the acquisition statement (Table 2).

As is evident from a quick glance at Table 1, the most striking trend is the interaction between instructional condition and type of feature recalled: Sex of the speaker was recalled well only in the Sex-Relevant condition, and language of the

message was recalled well only in the Language-Relevant condition. Neither feature was well retained in the Control condition. These conclusions are supported by an Analysis of Variance, in which there was a reliable interaction between instruction and feature, F (2, 69) = 48.62, MSE = .005. A Newman-Keuls analysis showed that language was recalled better by the Language-Relevant group than by the Sex-Relevant group, which was not reliably different from the Control group. Similarly, the sex feature was recalled better by the Sex-Relevant group than by the Languge-Relevant group, which was not reliably different from the Control group. Both main effects, type of feature and instruction, were also reliable, F (1, 69) = 18.23, MSE = .005 and F (2, 69) = 4.86, MSE = .011, respectively.

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Insert Table 1 here

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Each score in Table 1 was decomposed in Table 2 into the four possible test situations, depending upon the physical similarity between the acquisition and test statements. The four test situations were: acquisition and test statements match on both sex and language features, match on sex but not language, match on language but not on sex, and match on neither language nor sex. For example, the upper right hand score in each block refers to the situation in which the acquisition and test statements matched on the sex feature but did not match on language (e.g., the acquisition statement was presented in a ME voice and the test statement was in the MS voice). A preliminary analysis of these data showed that recall of the language feature was better when the test and acquisition statements were presented in the same language than in

different languages (.69 vs .61), F (1, 69) = 9.80, MSE = .026. There was no effect on language recall, however, of matching the sex of the acquisition and and test statements (.66 vs .64), $F<1$. The findings were parallel for recall of the sex feature. That is, recall was more accurate when the sex of the acquisition and test statements matched than when they mismatched (.71 vs .49), F (1, 69) = 48.88, MSE = .035. But there was no effect on recall of the sex feature as a function of matching the language of the acquisition and test statements (.60 vs .59), $F<1$.

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Insert Table 2 here

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A final analysis was conducted to examine whether the advantage of matching the acquisition and test statements on a given feature depended on the feature's relevance. For example, the language feature was better recalled when the acquisition and test statements were spoken in the same language than when they were spoken in different languages. Is the superior recall comparable when language is the relevant feature and when it is the irrelevant feature? To examine this question, we scored the data from only the Language-Relevant and Sex-Relevant conditions, as feature relevance is indeterminate in the Control condition. The results showed that the advantage of the matching over the non-matching test item was geater for the irrelevant feature (.71 vs .43) than for the relevant feature (.76 vs .67), F (1, 47) =

14.69, MSE = .027.

Discussion

The generally superior performance in the Language-Relevant and Sex-Relevant groups over the Control group is similar to the pattern found in Exp. 1 and suggests that providing an interpretive framework facilitates later memory (Bransford & Johnson, 1972). In light of the courtroom setting and the subjects' cover task, the speaker's identity became a meaningful component when combined with the semantic content of the statement. Now, whereas the speaker was defined by two attributes, sex and language, only one was relevant in each condition. In the Language-Relevant condition, for example, the meaning of a statement depended only on whether it was made by a member of the English-speaking household or by a member of the Spanish-speaking household. Within a household, the meaning of a statement was unaffected by the speaker's sex. An event's meaningfulness then, in comparison to its fixed dictionary definition, is heavily determined by the specific task demands, so that what is meaningful in one interpretive framework may be irrelevant in another. And it is the event's meaningfulness that largely determines its memorability. We suspect that the process by which meaning affects memory is similar to the manner described in Exp. 1. That is, the subject combines the statements made by the two members of each household into a general theme and then compares the test statement to the themes representing the two respective households. Authorship of the original statement is attributed to the closer of the two

themes.

It is apparent that relevance to the experimental task was not the only determinant of memorability. There were at least two other factors. First, the language feature was on the whole better remembered than the sex feature. As seen in Table 1, language was recalled better than sex when they were both the irrelevant feature (.58 vs .56), when they were both the relevant feature (.76 vs .67), and even in the Control condition where no framework was explicitly provided (.61 vs .57). We neither anticipated this finding nor can we offer an explanation with any confidence other than to say that it is unrelated to meaningfulness as determined by the experimental task. The second finding, which also suggests that memory is governed by factors other than meaningfulness, is that recall was generally better when the test statement and the acquisition statement were physically similar (e.g., both in English) than when they were dissimilar. The superior recognition with a matching test probe corroborates the earlier findings of Craik and Kirsner (1974), Geiselman and Glenny (1977), and Geiselman and Bjork (1980) and lends support to the position that memory is mediated in part by a retrievable episodic trace.

If there is an episodic trace that may be later retrieved, how are the sex and language features represented: Are they stored independently or in a unitary trace? Two pieces of evidence suggest that the features are stored independently (cf. Galbraith, 1975). First, the advantage of matching the acquisition and test items obtained only for recall of the

matching feature. That is, matching the test and acquisition statements on language enhanced memory for language, but it had no effect on recall of sex of the speaker. Similarly, matching the test and acquisition statements on sex of the speaker facilitated memory for speaker's sex, but it had no effect on recall of the language of presentation. Thus, the advantage of the matching test item is not in accessing a unitary trace, but in accessing a component of a complex set of features. Second, if a unitary trace existed, one would expect that either the code was accessed at the time of retrieval and all of the features were recoverable, or the code was inaccessible at retrieval and none of the features was recoverable. It is difficult to imagine how an intact unitary code could be accessed, yet the various features be differentially recoverable. This is especially true in the present case, as the features are integral in nature (Garner, 1974). Nevertheless, in the present experiment the sex feature was better recovered than the language feature in the Sex-Relevant condition and the opposite was true in the Language-Relevant condition.

Thus far, we have suggested that recall of the speaker's identity could be mediated by either a constructive process or by retrieval of an episodic trace (see Fisher & Bixby, Note 1, and Reder, in press, for comparable suggestions using radically different experimental procedures). For our purposes there are two major differences between these two modes of recall. First, in episodic trace retrieval, the speaker's identity is explicitly represented in the retrieved trace, whereas in constructive

recall, it is inferred from the comparison between the test statement and the two abstract, thematic codes. Second, in episodic trace retrieval, the retrieval process is guided by both the semantic and the physical features of the test item, whereas for constructive recall it is guided by only the semantic features of the test item. As a consequence, the benefit of matching the physical characteristics of the acquisition and test statements should be greater when recall is mediated by trace retrieval than by a constructive process. Presumably, only the relevant feature in the Sex-Relevant and Language-Relevant conditions can be inferred by the constructive process. Memory for the irrelevant feature requires retrieving the episodic trace. As such, the advantage of a matching over a non-matching test item should be greater for recall of the irrelevant feature than for the relevant feature. As can be seen in Table 2, this pattern obtained, although for some unknown reason, the effect was larger for the sex feature.

General Discussion

There is an interesting parallel between the present results and related studies in the literature, which may help explain why memory is enhanced when an event is learned as part of an integrated structure. We have known for a long time that "organization" improves retention (e.g., Bower, Clark, Lesgold, & Winzenz, 1969). More important, for the present analysis, is that the benefit of organization depends upon the test conditions. Typically, the effect is greater for recall tests than for recognition tests (McCormack, 1972). That is, when the

test item is similar in form to the acquisition event, as in recognition, there is a smaller effect of structural organization. So too in the present experiment: The relevance of a feature had a smaller effect when the test statement was given in the same form as the acquisition event. In our terms, when the episodic trace is easily accessed by a matching test item, the advantage of an intact thematic code is diminished. As another parallel in the literature, Geiselman and Bjork (1980) instructed their subjects to learn word trigrams by either maintenance (rote) rehearsal or by elaborative (meaningful association) rehearsal. After the initial learning phase, there was a recognition test in which the trigrams were re-presented either in a voice that was the same as the acquisition voice or in a different voice. Analogous to the present results, Geiselman and Bjork found that testing in the same voice as acquisition had a larger effect for the maintenance rehearsal than for the elaborative rehearsal. In our terms, the beneficial effects of matching the test and acquisition events is in retrieving the episodic trace, which should be most helpful when there is no thematic code to mediate memory, as in the rote rehearsal condition. To resolve our initial question, then, perhaps memory is enhanced when an event is learned as part of an integrated structure because the thematic code can be used to reconstruct the original event. By so doing, it makes memory less dependent upon retrieving the original episodic trace and therefore less dependent upon having to reinstate the acquisition environment at the time of retrieval.

One critical observation that has been raised by one of the reviewers is that the experiment does not really examine "memory" of the speaker's voice or language of presentation per se. Rather, subjects can solve the problem of who must have spoken the test statement originally by comparing it to the positions adopted by the two households. That is, language and voice information are given in the Language-Relevant and Voice-Relevant conditions, respectively, and therefore we are really describing problem-solving behavior and not memory. We agree in part. The underlying processes that account for the phenomenon of memory may well be similar to those involved in problem-solving. We probably use information from a variety of sources, even some unrelated to the original perceptual experience, to help reconstruct it (Loftus, 1979; Spiro, 1977). That the phenomenon of memory arises from such processes does not invalidate its memorial character. Memory is a phenomenon to be explained and does not preclude the possibility of any underlying processes. That it appears to share some operations with other cognitive abilities, like perception and problem-solving, ought not be a source of confusion but a source of insight into the more general principles of human cognition.

Reference Note

1. Fisher, R. P. & Bixby, D. T. Thematic construction vs trace retrieval operations in memory. Manuscript submitted for publication, 1981.

References

Bower, G. H., Clark, M. C., Lesgold, A. M., & Winzenz, D. Hierarchical retrieval schemes in recall of categorized word lists. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 323-343.

Bransford, J. D., & Franks, J. J. The abstraction of linguistic ideas. Cognitive Psychology, 1971, 2, 331-350.

Bransford, J. D., Franks, J. J., Morris, C. D., & Stein, B.S. Some general constraints on learning and memory research. In L. S. Cermak & F. I. M. Craik (Eds.), Levels of processing in human memory. Hillsdale, N.J.:Erlbaum, 1979.

Bransford, J. D., & Johnson, M. K. Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 717-726.

Bryden, M. P. Attentional strategies and short-term memory in dichotic listening. Cognitive Psychology, 1971, 2, 99-116.

Craik, F. I. M. Levels of processing: Overview and closing comments. In L. S. Cermak & F. I. M. Craik (Eds.), Levels of processing in human memory. Hillsdale, N.J.: Erlbaum, 1979.

Craik, F. I. M. & Kirsner, K. The effect of speaker's voice on word recognition. Quarterly Journal of Experimental

Psychology, 1974, 26, 274-284.

Craik, F. I. M. & Lockhart, R. S. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 671-684.

Craik, F. I. M. & Tulving, E. Depth of processing and the retention of words in episodic memory. Journal of Experimental Psychology: General, 1975, 104, 268-294.

Crowder, R. G. & Morton, J. Precategorical acoustic storage (PAS). Perception & Psychophysics, 1969, 5, 365-373.

Fisher, R. P. Interaction between encoding distinctiveness and test conditions. Journal of Experimental Psychology: Human Learning and memory, 1981, 7, 306-310.

Galbraith, R. C. On the independence of attributes of memory. Journal of Experimental Psychology: Human Learning and Memory, 1975, 1, 23-30.

Garner, W. R. The processing of information and structure. New York: Wiley, 1974.

Geiselman, R. E. Inhibition of the automatic storage of speaker's voice. Memory & Cognition, 1979, 7, 201-204.

Geiselman, R. E., & Bellezza, F. S. Long-term memory for speaker's voice and source location. Memory & Cognition, 1976, 4, 483-489.

Geiselman, R. E., & Bellezza, F. S. Incidental retention of speaker's voice. Memory & Cognition, 1977, 5, 658-665.

Geiselman, R. E. & Bjork, R. A. Primary versus secondary rehearsal in imagined voices: Differential effects on recognition. Cognitive Psychology, 1980, 12, 188-205.

Geiselman, R. E. & Glenny, J. Effects of imagining speaker's voices on the retention of words presented visually. Memory & Cognition, 1977, 5, 499-504.

Hintzman, D. L., Block, R. A., & Inskeep, N. R. Memory for mode of input. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 741-749.

Hyde, T. S. & Jenkins, J. J. Differential effects of incidental tasks on the organization of a list of highly associated words. Journal of Experimental Psychology, 1969, 82, 472-481.

Kirsner, K. An analysis of the visual component in recognition memory for verbal stimuli. Memory & Cognition, 1973, 1, 449-453.

Kolers, P. A. & Ostry, D. Time course of loss of information regarding pattern analyzing operations. Journal of Verbal Learning and Verbal Behavior, 1974, 13, 599-612.

Loftus, E. F. The malleability of human memory. American Scientist, 1979, 67, 312-320.

McCormack, P. D. Recognition memory: How complex a retrieval system? Canadian Journal of Psychology, 1972, 26, 18-41.

Reder, L. R. Plausibility judgments vs fact retrieval: Efficient strategies for question-answering. Psychological Review, in press.

Spiro, R. J. Remembering information from test: The "state of schema" approach. In R. C. Anderson, R. J. Spiro, & W. E. Montague (Eds.) Schooling and the acquisition of knowledge. Hillsdale, N. J.: Erlbaum, 1977.

Wickens, D. D. Encoding categories of words: An empirical approach to meaning. Psychological Review, 1970, 77, 1-15.

Footnotes

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1. In a recent updating of the levels of processing approach, Craik (1979) has suggested that sensory features can be processed deeply if they are associated with other "rich" sources of information, e.g., recognizing a friend's voice.

Table 1

Probability of Recalling Sex and Language as a function of Instructions

	Instruction		
Feature Recalled	Sex-Relevant	Language-Relevant	Control
Sex	.67	.56	.57
Language	.58	.76	.61